

The Scottish Mathematical Council

www.scot-maths.co.uk

MATHEMATICAL CHALLENGE 2013–2014

Entries must be the unaided efforts of individual pupils.

Solutions must include explanations and answers without explanation will be given no credit.

Do not feel that you must hand in answers to all the questions.

CURRENT AND RECENT SPONSORS OF MATHEMATICAL CHALLENGE ARE

The Edinburgh Mathematical Society, The Maxwell Foundation, Professor L E Fraenkel,

The London Mathematical Society and The Scottish International Education Trust.

The Scottish Mathematical Council is indebted to the above for their generous support and gratefully acknowledges financial and other assistance from schools, universities and education authorities.

Particular thanks are due to the Universities of Aberdeen, Edinburgh, Glasgow, Heriot Watt, Stirling, Strathclyde and to Preston Lodge High School, Bearsden Academy, Beaconsfield School and Northfield Academy.

Middle Division: Problems 2

- M1.** A block of four postage stamps, with perforations along the joins so that they can be easily separated, have values in pence as shown:

1	2
4	3

Show that it is possible to make every postage value from 1p to 10p using either a single stamp or a number of stamps joined along lines of perforations.

Using a different set of stamp values in the block of four, it is possible to make every postage value from 1p to a higher limit than 10p. Construct an arrangement of stamp values which reaches the highest possible limit.

Are there any other solutions which give this limit? Explain.

- M2.** A brother and sister, Peter and Fiona, are always thinking about numbers.

On his birthday Peter said "My age is a square number."

His older sister Fiona said "That's right, but the sum of our ages and the difference of our ages also give squared numbers."

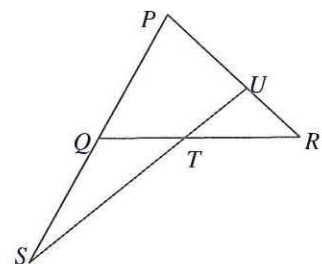
Peter replied "In three years time, both our ages will be prime numbers."

Fiona replied "Three years ago, both our ages were also prime numbers."

What are the ages of Peter and Fiona now?

- M3.** PQR is any triangle. The side PQ is extended to S where $PQ = QS$. The point U divides the side PR in the ratio $3 : 2$. The point T is where the lines QR and SU cross.

Find the ratio $\frac{QT}{QR}$.



- M4.** Rebecca celebrated her graduation by going for a hot air balloon ride. At first the wind blew the balloon $\frac{1}{2}$ a mile due east. Then the balloon was blown $\frac{3}{4}$ of a mile southwest. Finally, it was blown $\frac{1}{2}$ a mile north and then landed. How many miles did the balloon land from the point where it was launched? Express your answer as a decimal to three places.

Do not use a scale drawing.

SEE OVER FOR QUESTION M5.



Mathematical Challenge Problems 2

MIDDLE DIVISION 2013–2014

PLEASE USE CAPITALS TO COMPLETE

SURNAME

OTHER NAME(S)
(underline the one
you prefer)

SCHOOL

AGE

YEAR OF STUDY

FOR OFFICIAL USE

Marker

Marks

1	2	3	4	5

Total

— — — — - CUT ALONG HERE — — — —

Please write your solutions on A4 paper and staple the above form to them.

PLEASE WRITE YOUR NAME ON EVERY PAGE.

Send your entry directly or through your school to :

Ruth Forrester,

University of Edinburgh, Moray House Institute of Education,
Holyrood Rd., Edinburgh, EH8 8AQ

For further information on the competition, please see the Information Circular, which has been distributed to all secondary schools. Please contact the local organiser, whose name and address are given above, if you require a further copy.

- M5.** Dots are arranged in a rectangular grid with 4 rows and n columns. Consider different ways of colouring the dots, in which each dot either red or blue. A colouring is 'good' if no four dots of the same colour form a rectangle with horizontal and vertical sides.
Find the maximum value of n for which there is a good colouring.

END OF PROBLEM SET 2

CLOSING DATE FOR RECEIPT OF SOLUTIONS :

14th February 2014

Look on the SMC web site:

www.scot-maths.co.uk

for information about Mathematical Challenge